ELECTRIC HEATER EMPLOYING SEMICONDUCTOR HEATING ELEMENTS

FIELD OF THE INVENTION

The invention relates to forced-air electric heaters, and more particularly to improvements in the construction of electric heaters incorporating semiconductor heating elements.

BACKGROUND OF THE INVENTION

Electric heaters employing semiconductor heating elements represent a marked improvement over prior resistance-wire type heaters. These new heaters include heating elements which consists of a planar core of semiconductor material formed with a multiplicity of apertures that permit passage of air to draw heat from the core. Opposing faces of the core are coated with electrically conductive coatings that produce a fairly even distribution of current flow in the core when a voltage difference is applied to the coatings. These heaters tend to be more durable than prior resistance-wire type heaters, tend to be more compact for a given heat requirement, and have the additional advantage that very hot air flows can be produced while the temperature of the associated heating element remains below about 200 degrees centigrade, thereby reducing the risk of fire, particularly where there are flammable materials in the heated environment. Such a heater was proposed by me in my Canadian Pat. No. 1,119,579.

Heaters incorporating semiconductor heating elements of the type described above are still relatively novel, and a number of problems have arisen in the construction of such heaters. In particular, a convenient, inexpensive mechanism is required to hold the heating elements. The exact manner in which the heating elements are held tends to be more critical in the new type heaters than in the old resistance-wire type, as the heating elements tend to be smaller, and air flows from an associated fan must consequently be more tightly constrained to achieve the full benefit of employing such heating elements. As well, because of the size and nature of the heating elements, considerable care must be taken to ensure simultaneous electrical and thermal isolation of the heating elements from any associated housing, and proper electrical contact with a supply of line voltage. Moreover, it is desirable to improve the heat transfer efficiency of such a heater, and to provide quieter operation, operation tending to be noisy because of the extent to which air flows are affected by the limited cross-sectional area of the new heating elements.

Accordingly, it is one object of the present invention to provide a heater construction employing semiconductor heating elements of the type described above which results in improved heat transfer and quiet operation.

It is another object of the invention to provide a convenient, inexpensive mechanism for holding and electrically contacting semiconductor heating elements of the type described above.

BRIEF SUMMARY OF THE INVENTION

The invention provides an electric heater which includes a housing having a rear air inlet and a forward air outlet. A fan is mounted inside the housing intermediate of the rear air inlet and the forward air inlet to produce an air flow through the housing. The fan is of a type which includes a fan venturi that directs air flow generated by the fan from a rear venturi opening (which is placed in communication with the rear air inlet of the housing) to a forward venturi opening.

The fan air flows are heated by a multiplicity of disk-shaped heating elements. Each heating element includes a generally planar core with a pair of opposing forward and rear core faces, electrically conductive coatings covering each of the opposing faces, and a multiplicity of apertures which permit air flow through the core. The cores are formed of a semiconductor material with preferrably a positive resistance-temperature coefficient (PTC), the significance of which will be discussed below in connection with a preferred embodiment of the invention.

A heating element holder formed of an electrically insulating and heat-insulating material is mounted in the housing intermediate of the forward fan venturi opening and the forward air outlet of the housing. The holder includes holding means which maintain the heating elements in generally coplanar, spaced-apart relationship relative to one another. When the holder is in an operative position, the heating elements are oriented generally perpendicular to the longitudinal axis of the fan venturi and spaced forwardly therefrom, with each rear core face facing toward the forward venturi opening.

The holder is adapted to direct air flows escaping from the forward fan venturi opening through the cores. Accordingly, the holder comprises air flow receiving means, including a recess formed in a rear face of the holder and positioned at the forward fan venturi opening, which receive substantially all air flow from the forward venturi opening in the recess. A multiplicity of passages in the holder guide air received in the recess through the heating elements. Each passage extends between a forward face and the rear face of the holder, and each passage has a forward opening in the forward face of the holder and a rear opening in the recess, spaced forwardly of the forward fan venturi opening. Each passage is associated with a different one of the heating elements, the associated heating element being positioned intermediate of the forward and rear passage openings, and positioned so that all air flow in the passage is constrained to flow through the core.

The passage and the recess are shaped or dimensioned to provide a smooth air flow through the cores. In particular, each of the passages has a minimum cross-sectional area which corresponds substantially to the cross-sectional area of the associated heating element. Each passage is flared rearwardly and radially outwardly from the rear face of the associated heating element to guide air flows smoothly towards the heating element. The recess is similarly flared, radially outwardly and rearwardly, from about the rear passage openings to the rear face of the holder. The flaring which may be either convex or concave result in less turbulent air flows and consequently quieter operation.

Electrical connection means are provided which extend into the holder for placing the coatings of each heating element in contact with the source of electric power, and also serve to place the fan in contact with the source of power.

Other aspects and advantages of the present invention, particularly a novel heating element holder, will be apparent from the description below of a preferred embodiment.